Published in final edited form as:
Curr Opin Otolaryngol Head Neck Surg. 2012 February ; 20(1): 29–32. doi:10.1097/MOO.0b013e32834dfb3d.

Olfactory Improvement after Endoscopic Sinus Surgery

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Abstract

Purpose of review—Olfactory dysfunction is a common complaint in patients with chronic rhinosinusitis (CRS). The purpose of this article is to review the current evidence on the impact of ESS on CRS-related olfactory dysfunction.

Recent findings—The recent literature suggests that olfactory outcomes after ESS are challenging to predict. Some evidence supports a positive impact of ESS on improving olfactory outcomes in patients with preoperative nasal polyposis and anosmia. However, despite improvements in smell, most of theses patients remain with severe hyposmia. One study suggests ESS has no impact on olfactory outcomes.

Summary—CRS-related olfactory dysfunction is a complex clinical scenario and it is challenging to predict improvement following ESS. CRS patients with anosmia and nasal polyposis preoperatively may have a higher likelihood of olfactory improvement following ESS.

Keywords

Olfaction; Chronic Rhinosinusitis; Sinusitis; and Endoscopic sinus surgery

Introduction

The sense of smell provides several important functions such as protection from the environment (i.e. sensing spoiled foods, gas leaks, or smoke), taste, and is implicated in a person's overall quality of life[1]. Normal olfaction depends on the culmination of several important physiologic steps, beginning with external odorants contacting olfactory epithelium located along the posterior superior nasal septum, olfactory cleft, and superior portions of the superior and middle turbinates. Odorants then bind unique bipolar neuron receptors resulting in a complex neurosignalling cascade through the olfactory bulb ending with olfactory cortex stimulation. Disruption anywhere along this pathway can result in olfactory impairment.

Olfactory dysfunction affects approximately 10 million people each year in the US and the risk dramatically increases with age[2]. Hundreds of etiologies have been implicated in its pathogenesis while the three most common causes include viral injury, sinonasal disease

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Conflict of Interest: There are no conflicts of interest for Luke Rudmik, MD or Timothy L. Smith, MD, MPH. Timothy L. Smith receives grant funding from the National Institute on Deafness and Other Communication Disorders, one of the National Institutes of Health, Bethesda, MD., and is a consultant for IntersectENT (Palo Alto, CA.) which provided no funding for this review.

(i.e. chronic rhinosinusitis (CRS) and nasal polyposis), and traumatic injury[3–5]. Dysfunction can range from varying degrees of reduced smell (hyposmia) to complete loss of smell (anosmia). Other dysfunctions include distorted smell (dysguesia) and smell in the absence of an external stimulus (phantosmia). Most olfactory testing is performed with validated psychological subjective tests (i.e. Smell Identification Test) while objective electrophysiologic testing has limited clinical utility and is typically reserved for research purposes.

Management of olfactory dysfunction is primarily focused on education of hazard avoidance and treatment of the underlying etiology. This review article will discuss the impact of CRS on olfactory function and the impact of endoscopic sinus surgery (ESS) on olfactory outcomes.

Olfactory Testing

The majority of olfactory disorders can be diagnosed with a thorough history, physical exam, and rigid sinonasal endoscopic evaluation. Although rarely indicated, olfactory testing may be indicated to provide objective information pertaining to the degree of dysfunction. Testing can often be organized into two categories: 1) Psychological, and 2) Electrophysiologic[6, 7]. Since psychological tests are easier to administer, they are most commonly used in clinical practice, while electrophysiologic testing is primarily reserved for research purposes. This section will briefly discuss the three most common clinical tests for olfactory function: The Smell Identification Test (SIT), Butanol threshold test, and Sniffin' sticks.

Smell Identification Test

The Smell Identification Test (SIT) utilizes a scratch and sniff format which provides excellent test-retest reliability and has been validated in several different populations and disease states. It is composed of 40 odors with a selection of four corresponding answer options per odor. Patients take the exam alone and are instructed to guess at the answer even if they cannot smell the odor. Anosmic patients should receive a score of approximately 10/40 since random answer selection should result in a score of 25%. Malingering patients will intentionally pick the wrong answer and often result in a score less than 10/40. The final scores are then compared to normal age-matched norms and the results are analyzed.

Butanol Threshold Test

The butanol threshold test involves the identification of a solution containing butyl alcohol. The patient sniffs two bottles, one contains water and the other contains a specific concentration of butanol, with each nostril tested separately. After every incorrect identification response, the concentration of butanol is increased by a factor of 3 until one of the following is occurs: 1) the patient is able to correctly identify the butanol bottle 5 responses in a row or 2) until the concentration of butanol reaches 4%. The concentration threshold is then compared to age-matched norms and the results are analyzed.

Sniffin' Sticks Test

Sniffin sticks testing utilize a series of reusable n-butanol pens, which contain different concentrations of odor. The test contains three parts and should be performed in the following order: 1) threshold test for butanol, 2) discrimination of odors, and 3) identification of odors. The patient is blind folded and the odorant pens are presented 2 cm from an isolated nostril. For threshold testing, the pens are labeled from 1 (highest concentration) to 16 (lowest concentration) and the examiner begins by presenting pen-16 and continues to increase the concentration until the patient correctly identifies the butanol

pen at least twice. During discrimination testing, patients are presented with a triplet of pens, with one of the three pens containing a unique odorant. The patient is asked to identify the unique odorant pen. Identification testing is similar to the SIT, whereby an odorant pen is provided and the patient is asked to provide the correct odor from a list of four responses.

Olfactory Dysfunction in Chronic Rhinosinusitis

Olfactory dysfunction is a common complaint and affects approximately 65% to 80% of patients with CRS[8–10]. Although the exact pathogenesis of CRS-induced olfactory dysfunction is unknown, impairment is likely due to a combination of mechanical obstruction from edematous mucosa or polyposis, and injury to the olfactory neuroepithelium from chronic inflammation. A study by Kern demonstrated that patients with anosmia and CRS had significant levels of inflammation located within the olfactory neuroepithelium, which may injure bipolar neurons and impair neurogenesis[11]. To build upon the findings from the Kern study, several recent studies have evaluated the impact of histologic markers on olfactory dysfunction in patients with CRS. A study by Soler et al. demonstrated that mucosal eosinophilia predicted olfactory impairment with worse olfactory SIT scores compared to CRS patients with lower levels of mucosal eosinophils[12]. Furthermore a study by Hox et al. demonstrated that blood eosinophilia correlated with olfactory dysfunction while the presence of staphylococcus aureus and total serum IgE levels failed to correlate with impairment[13].

To improve diagnosis and counseling of patients, predictive factors for olfactory dysfunction have been studied. A recent study by Litvack et al. evaluated the predictors of olfactory dysfunction in patients with CRS and demonstrated that nasal polyposis, asthma, age, and smoking were stronger predictors of impairment[14]. A history of endoscopic sinus surgery (ESS) and allergic rhinitis failed to predict olfactory impairment.

There have been several studies which demonstrate that olfactory dysfunction is associated with reduced quality of life (QoL) [1, 5, 15–19]. Reduction in QoL is primarily related to impaired interpersonal relationships, diminished food enjoyment and fear of associated risks from smell loss[20]. These studies utilized general QoL instruments such as the SF-36 instrument which focus on global QoL status. In contrast to prior studies, a recent large prospective study by Litvack et al. provided evidence that olfactory impairment was not correlated with reduced CRS-specific HRQoL and general QoL[8]. This study utilized the Rhinosinusitis Disability Index (RSDI) and Chronic Sinusitis Survey (CSS) HRQoL instruments and the SF-36 general QoL instrument. The results demonstrated a positive correlation between olfactory impairment and CRS disease severity on computed tomography (CT) and endoscopy but failed to demonstrate a correlation between olfactory impairment and QoL. They conclude that olfactory impairment may act as a measure of CRS disease severity but has limited correlation to CRS-specific QoL status.

Olfactory dysfunction is common in patients with CRS and should be addressed during routine evaluation. Despite some conflicting evidence about the impact of smell disturbances on QoL, patients should be counseled on risk management and psychological interventions such as coping strategies and cognitive therapy should be considered to optimize the patients QoL[20].

Olfactory Outcomes after Endoscopic Sinus Surgery

The goal of endoscopic sinus surgery (ESS) for medically refractory CRS is to optimize sinus function and improve access for topical medical therapy. There is substantial evidence for the beneficial effects of ESS on CRS-related outcomes such as endoscopic scores, computed tomography (CT) grading, histologic markers, patient symptoms, and

HRQoL[9, 21, 22]. However, olfactory outcomes following ESS can be variable and challenging to predict. Early studies supported the role of ESS to improve CRS-related olfactory dysfunction[23–29]. However, several recent larger prospective studies have improved our understanding of the impact of ESS on CRS-related olfactory dysfunction and have begun to elucidate the predictive factors associated with olfactory improvement.

In 2009, Litvack et al. reported a prospective trial of 111 patients with olfactory impairment undergoing ESS for medically refractory CRS[30]**. The results demonstrated that olfactory impairment improved following ESS for anosmic patients but not for patients with hyposmia. The improvements for anosmic patients were stable after 1 year follow-up. They hypothesized that anosmic patients typically had a mechanical obstruction to the olfactory cleft which was amenable to surgical removal. As compared to hyposmic patients which likely suffered from a multi-factorial etiology of olfactory impairment with chronic neuroepithelial inflammation and damage which was less amenable to ESS optimization. The only predictive factor for post-ESS olfactory improvement was the presence of nasal polyposis. Factors such as age, allergy status, ASA intolerance, and history of prior ESS were not predictive factors.

A large prospective study by Pade et al. evaluated 206 patients with olfactory impairment who elected ESS for CRS[31]. They demonstrated that 23% of patients received improvement, 68% received no change, and 9% got worse after ESS. The results suggested that the presence of nasal polyposis and eosinophilia predicted olfactory improvement

In contrast to the above studies, a recent study by Jiang et al. evaluated the impact of ESS on olfactory outcomes in patients with medically refractory CRS[10]. They demonstrated that ESS had no impact on olfactory improvement. In a subsequent article by Jiang et al. they attempted to identify predictive factors for olfactory improvement following ESS[32]*. The results demonstrated no predicative correlation between olfactory improvement following ESS and the degree of nasal obstruction, severity of CRS, presence of nasal polyposis, or allergy status. This is contrast to the studies by Litvack et al and Pade et al. whereby the presence of nasal polyposis predicted olfactory improvement following ESS.

In 2010, Soler et al. evaluated the impact of histologic markers on olfactory outcomes following ESS[33]*. They identified that olfactory impairment correlated with higher degrees of tissue eosinophilia and basement membrane thickening. However, after controlling for nasal polyposis, none of the inflammatory histologic markers predicted olfactory improvement following ESS. Furthermore, 75% of anosmic patients received olfactory improvement after ESS, however, despite improvement, most of these patients remained with residual severe hyposmia. This suggests that most patients with CRS and olfactory impairment suffer from some form of permanent neuroepithelial injury.

Overall, the evidence suggests that improvement of CRS-related olfactory dysfunction following ESS is variable and challenging to predict. Although there is some conflicting evidence, it appears that anosmic patients with nasal polyposis have a higher likelihood of improving their sense of smell following ESS. As compared to CRS patients with hyposmia without nasal polyposis. Future research will need to further elucidate the role of ESS for CRS-related olfactory dysfunction.

Conclusion

Olfactory dysfunction is a common complaint is patients with CRS. The underlying pathophysiology is complex and multifactorial, likely related to mechanical obstruction and neuroepithelial injury from chronic inflammation. Due to the negative impact on patient QoL, olfactory dysfunction should be addressed during the evaluation of CRS. Improvement

of olfactory dysfunction following ESS is challenging to predict. The evidence suggests that patients with anosmia and nasal polyposis may have a higher chance of olfactory improvement following ESS. Whereas, hyposmic patients without nasal polyposis have a lower likelihood to improve following ESS. Future research will need to further investigate the role of histologic markers as predictive factors in olfactory improvement following ESS.

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Table 1

Key Points

• Olfactory dysfunction is commonly associated with chronic rhinosinusitis
• Olfactory outcomes are challenging to predict after ESS
• Preoperative anosmia and nasal polyposis may predict improved olfactory outcomes after ESS